ION IMPLANTATION ION SOURCE, SYSTEM AND METHOD

ABSTRACT OF THE DISCLOSURE

[00259] Various aspects of the invention provide improved approaches and methods for efficiently:

- Vaporizing decaborane and other heat-sensitive materials via a novel vaporizer and vapor delivery system;
- Delivering a controlled, low-pressure drop flow of vapors, e.g. decaborane, into the ion source;
- Ionizing the decaborane into a large fraction of $B_{10}H_x^+$;
- Preventing thermal dissociation of decaborane;
- Limiting charge-exchange and low energy electron-induced fragmentation of $B_{10}H_x^+$;
- Operating the ion source without an arc plasma, which can improve the emittance properties and the purity of the beam;
- Operating the ion source without use of a strong applied magnetic field, which can improve the emittance properties of the beam;
- Using a novel approach to produce electron impact ionizations without the use of an arc discharge, by incorporation of an externally generated, broad directional electron beam which is aligned to pass through the ionization chamber to a thermally isolated beam dump;.
- Providing production-worthy dosage rates of boron dopant at the wafer;
- Providing a hardware design that enables use also with other dopants, especially using novel hydride, dimer-containing, and indium- or antimony-containing temperature-sensitive starting materials, to further enhance the economics of use and production worthiness of the novel source design and in many cases, reducing the presence of contaminants;
- Matching the ion optics requirements of the installed base of ion implanters in the field;
- Eliminating the ion source as a source of transition metals contamination, by using an external and preferably remote cathode and providing an ionization chamber and

extraction aperture fabricated of non-contaminating material, e.g. graphite, silicon carbide or aluminum;

- Enabling retrofit of the new ion source into the ion source design space of existing Bernas source-based ion implanters and the like or otherwise enabling compatibility with other ion source designs;
- Using a control system in retrofit installations that enables retention of the installed operator interface and control techniques with which operators are already familiar;
- Enabling convenient handling and replenishment of the solid within the vaporizer without substantial down-time of the implanter;
- Providing internal adjustment and control techniques that enable, with a single design, matching the dimensions and intensity of the zone in which ionization occurs to the beam line of the implanter and the requirement of the process at hand;
- Providing novel approaches, starting materials and conditions of operation that enable the making of future generations of semiconductor devices and especially CMOS source/drains and extensions, and doping of silicon gates.